JAPANESE [JP,11-320269,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to an electrode-for-electric-spark-machining line, and relates to a covered type electrode-for-electric-spark-machining line especially.
[0002]
[Description of the Prior Art] There is a Cu-35Zn alloyed wire (65 / 35 brass lines) which Zn concentration becomes from the Cu-35Zn alloy simple substance which is 32 - 36wt% as an electrode-for-electric-spark-machining line currently generally used.
[0003] In addition, what formed the enveloping layer which becomes a steel-wire periphery from a Cu-35Zn alloy as an electrode-for-electric-spark-machining line of high intensity is known. Cu alloyed wire which furthermore consists of Cu-0.15Sn and Cu-0.15Ag is made into a core wire, and the thing in which the enveloping layer which becomes the periphery of this core wire from a Cu-35Zn alloy was formed is known (JP,6-47130,B).
[0004] Moreover, the working speed of an electron discharge method is sped up and the method of raising Zn concentration of Cu-Zn, the method of adding aluminum etc. to Cu-Zn and raising thermal resistance, etc. are learned as a method of obtaining an efficient electrode-for-electric-spark-machining line (the Koga electrical engineering time signal, No. 75 (March, Showa 60)).
[0005] In recent years, Cu alloyed wire which improvement in the further electron discharge method speed (efficient-izing) is desired, for example, consists of Cu-2.0Sn, Cu-0.3Sn, Cu-13Zn, Cu-0.6Ag, and Cu-4.0Zn-0.3Sn is made into a core wire from a viewpoint of productivity, and the covered type electrode-for-electric-spark-machining line which formed the Cu-Zn alloy-plate layer of high Zn concentration in the periphery of this core wire is proposed (JP,5-339664,A).
[0006]
[Problem(s) to be Solved by the Invention] However, since Zn concentration of a Cu-Zn alloy-plate layer of this electrode-for-electric-spark-machining line is 38 - 49wt%, a Cu-Zn alloy-plate layer serves as a mixed organization of alpha phase and beta phase, or a single phase organization of beta phase. Since cold working becomes difficult along with the increase in beta phase, this electrode-for-electric-spark-machining line is unproducible only by the method by high hot working (hot-extrusion processing) of processing cost. That is, production of this electrode-for-electric-spark-machining line had the problem that a manufacturing cost became high.
[0007] Moreover, since Cu-2.0Sn, Cu-0.3Sn, Cu-13Zn, Cu-0.6Ag, and Cu alloyed wire that consists of Cu-4.0Zn-0.3Sn are adopted as a core wire, Difficulty is in wire drawing nature (when it is Cu-2.0Sn), thermal resistance, i.e., a high temperature strength, is remarkably low, and it sets at the time of use. According to not being [generating and conductivity] enough by the line elongation before an open circuit or an open circuit (when it being Cu-13Zn) (when it being Cu-4.0Zn-0.3Sn), or thermal resistance not being enough [of an electric discharge unstable state] Since neither was able to enlarge the increase grade of electron discharge method speed enough and Cu alloy contained Ag, there was a problem that raw material cost generally became high. When saying about the core wire, since thermal resistance was not enough, the increase grade of electron discharge method speed was not able to be enlarged enough (Cu-0.15Sn) and Cu alloy contained Ag, Cu alloyed wire shown in JP,6-47130,B also had the problem that raw material cost generally became high.
[0008] Then, this invention solves the above-mentioned technical problem, its manufacturing cost is cheap, it has sufficient conductivity and a sufficient high temperature strength, and is to offer the

electrode-for-electric-spark-machining line to which electron discharge method speed can be made to fully increase by that cause.

[0009]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention of a claim 1 forms the enveloping layer of a Cu-Zn alloy in the periphery of the core wire which consists of a Cu-0.02 - 0.2Zr alloy or a Cu-0.15-0.25Sn-0.15 - 0.25In alloy.

[0010] Invention of a claim 2 forms the enveloping layer of the Cu-Zn alloy which becomes the periphery of the core wire which consists of a Cu-0.02 - 0.2Zr alloy or a Cu-0.15-0.25Sn-0.15 - 0.25In alloy from the single phase organization of alpha phase.

[0011] Invention of a claim 3 is an electrode-for-electric-spark-machining line according to claim 2 whose Zn concentration of the above-mentioned Cu-Zn alloy is 32 - 38wt%.

[0012] Invention of a claim 4 is an electrode-for-electric-spark-machining line according to claim 1 to 3 whose thickness of the above-mentioned enveloping layer is 30-40 micrometers.

[0013] Invention of a claim 5 forms the enveloping layer of the Cu-Zn alloy which becomes the periphery of the core wire which consists of a Cu-0.02 - 0.2Zr alloy or a Cu-0.15-0.25Sn-0.15 - 0.25In alloy from the mixed organization of alpha phase and beta phase.

[0014] The enveloping layer of the above-mentioned Cu-Zn alloy of invention of a claim 6 is an electrode-for-electric-spark-machining line according to claim 5 as for which Zn concentration of the surface section has become lower than Zn concentration of the interior.

[0015] this invention pays its attention to the core-wire material of the covered type electrode-for-electric-spark-machining line which formed the Cu-Zn alloy-plate layer in the periphery of a core wire.

[0016] Here, the selection range of a core wire was limited to Cu alloyed wire because difficulty was in the Masanao nature (a core set arises when it wound and unfolds) and there was a problem in respect of the ease of dealing with it to a finishing machine, when it is steel wire, and on the other hand, it is from a viewpoint that the higher one is desirable about conductivity in tensile strength (elevated-temperature tensile strength which assumed the time of use especially). In addition, since the tensile strength at the time of an elevated temperature was insufficient for Cu line, it was presupposed that it is out of range.

[0017] The reason for limitation of the above-mentioned numerical range is explained below.

[0018] About Zr concentration of a Cu-0.02 - 0.2Zr alloy, when Zr concentration was less than [0.02wt%], thermal resistance was insufficient, the electric discharge unstable state occurred and Zr concentration exceeded 0.2wt(s)%, while exceeding the dissolution limit of Zr, it limited to the range of 0.02 - 0.2wt% from the bird clapper that the crystallization object of Cu3 Zr is formed and it is easy to disconnect. Since Cu-0.05 whose Zr concentration is 0.05 - 0.16wt% in this - the 0.16Zr alloy are used as a Cu-0.16Zr alloy of a general-purpose article, they are the most economical in a Cu-Zr alloy.

[0019] Moreover, about Sn concentration and In concentration of a Cu-0.15-0.25Sn-0.15 - 0.25In alloy, although it is added in order that each of Sn and In(s) may raise alloy intensity, the influence the direction of Sn affects a conductivity fall compared with In is large. Since the direction with few conductivity falls for the improvement in an electric discharge property is desirable, it is more desirable than the addition of Sn to make [many] the addition of In sharply. However, since In is expensive, it is stopping the addition low with less than [0.25wt%]. For this reason, although the addition of Sn needed to be made [many], since the conductivity fall became remarkable when there were more amounts of Sn than 0.25wt(s)%, improvement in an electric discharge property and the balance of economical efficiency were considered, and it considered as the range of this composition.

[0020] In Zn concentration 32 - 38wt%, it can consider as the single phase organization of alpha phase, and although tensile strength and hardness increase along with the increase in Zn concentration, since it is not sufficiently hard, cold working of them is possible [within the limits of this alpha phase,] about Zn concentration of the enveloping layer of a Cu-Zn alloy. Therefore, manufacture by wire drawing etc. is easy. In this, Zn density range of the Cu-35Zn alloy (65/35 brass) known as a general-purpose article is shown Zn concentration 32 - 36wt%. Of course, this Cu-35Zn alloy consists of a single phase organization of alpha phase, and since it is a general-purpose article while cold working is easily possible, it excels also in respect of the availability in a commercial scene, and economical efficiency.

[0021] Moreover, about the thickness of the enveloping layer of a Cu-Zn alloy, thickness of a Cu-Zn alloy-plate layer was set to at least 30 micrometers or more to make it an open circuit not arise, in order to

exhaust about 30 micrometers of enveloping layers by the efficient electron discharge method, and since it became impossible to fill conductivity required as an electrode-for-electric-spark-machining line when thickness is thicker than 40 micrometers, it could be 40 micrometers or less.
[0022]
[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained.
[0023] The cross-sectional view of the electrode-for-electric-spark-machining line of this invention is shown in drawing 1 .
[0024] As shown in drawing 1 , the electrode-for-electric-spark-machining line 3 of this invention forms the Cu-Zn alloy-plate layer 2 which becomes the periphery of the core wire 1 which consists of a Cu-0.02 - 0.2Zr alloy (or Cu-0.15-0.25Sn-0.15 - 0.25In alloy) from the single phase organization of alpha phase, or the mixed organization of alpha phase and beta phase.
[0025] According to the electrode-for-electric-spark-machining line of this invention in which the enveloping layer of the Cu-Zn alloy which becomes the periphery of the core wire which consists of a Cu-0.02 - 0.2Zr alloy or a Cu-0.15-0.25Sn-0.15 - 0.25In alloy from the single phase organization of alpha phase was formed, formation by cold working can obtain a possible efficient electrode-for-electric-spark-machining line easily. That is, since a Cu-Zn alloy-plate layer is the single phase organization of alpha phase, the mechanical property of a Cu-Zn alloy-plate layer has tensile strength smaller than the brass metal which consists of a mixed organization of alpha phase and beta phase, or a single phase organization of beta phase, and its contraction percentage is large at ordinary temperature or low temperature, therefore its deformans is good. When a Cu-Zn alloy-plate layer is the single phase organization of alpha phase Although the grade of the increase of only the part to which Zn concentration falls in the electron discharge method speed of an electrode-for-electric-spark-machining line is small as compared with the case of the mixed organization of alpha phase and beta phase, or the single phase organization of beta phase By adopting the covered type structure which made the core wire the Cu-0.02 - 0.2Zr alloy or the Cu-0.15-0.25Sn-0.15 - 0.25In alloy, reduction of the grade of the increase in electron discharge method speed is limited to minimum. By this, electron discharge method speed of the electrode-for-electric-spark-machining line of this invention can be sharply made quicker than the electron discharge method speed of the electrode-for-electric-spark-machining line which consists of a Cu-35Zn alloy simple substance, even when a Cu-Zn alloy-plate layer is the simple tissue of alpha phase.
[0026] Moreover, since production of the electrode line by cold working is possible, processing cost can be held down low, as a result the manufacturing cost of an electrode-for-electric-spark-machining line can be held down low.
[0027] Furthermore, if acquisition uses the cheap and most popular Cu-35Zn alloy easily also in the brass metal marketed as a Cu-Zn alloy, the manufacturing cost of an electrode-for-electric-spark-machining line can be held down still lower.
[0028] On the other hand, although what a Cu-Zn alloy-plate layer becomes from the mixed organization of alpha phase and beta phase has the large grade of the increase in a part with high Zn concentration, and electron discharge method speed, cold working becomes difficult as the rate of beta phase increases. If Zn concentration of the surface section of a Cu-Zn alloy-plate layer is made low with heat treatment at this time, it will become very easy [the thing of high Zn concentration] cold working as a whole. In addition, what a Cu-Zn alloy-plate layer becomes from the single phase organization of beta phase is remarkably difficult cold working, and it made it out of range [this invention].
[0029]
[Example] (Example 1) It consists of Cu-0.16Zr, and it consists of Cu-35Zn, the core wire whose outer diameter is 7.1mm is inserted into the Cu-35Zn alloy pipe whose wall thickness an outer diameter is 10mm and is 1.2mm, and the multiple-unit tube is formed. In addition, what was produced as a Cu-35Zn alloy pipe using the usual extrusion is used.
[0030] After performing wire drawing to this multiple-unit tube and forming in phi0.9mm, it heat-treats for softening.
[0031] Finally, wire drawing is performed to a phi0.9mm compound line to phi0.25mm, and the electrode-for-electric-spark-machining line whose thickness Zn concentration of a Cu-Zn alloy-plate layer is 35wt (s)%, and is 31 micrometers is produced.
[0032] Moreover, it consists of Cu-0.16Zr, and it consists of Cu-40Zn, the core wire whose outer diameter

is 7.1mm is inserted into the Cu-40Zn alloy pipe whose wall thickness an outer diameter is 10mm and is 1.2mm, and the multiple-unit tube is formed. In addition, what was produced as a Cu-40Zn alloy pipe using the usual extrusion is used.
[0033] After performing wire drawing to this multiple-unit tube and forming in phi7.9mm, it heat-treats for softening. Next, after performing wire drawing to a phi7.9mm compound line and forming in phi1.2mm, it heat-treats again for softening.
[0034] Finally, wire drawing is performed to a phi1.2mm compound line to phi0.25mm, and the electrode-for-electric-spark-machining line whose thickness Zn concentration of a Cu-Zn alloy-plate layer is 40wt(s)%, and is 31 micrometers is produced.
[0035] (Example 2) It consists of Cu-0.19Sn-0.2In, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0036] (Example 1 of comparison) It consists of Cu-2.0Sn, and except using the core wire whose outer diameter is 7.1mm, fundamentally, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced. In addition, at this time, the core wire of Cu-2.0Sn was understood that wire drawing nature is not good, and the fabrication operation of an electrode-for-electric-spark-machining line was difficult.
[0037] (Example 2 of comparison) It consists of Cu-0.3Sn, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0038] (Example 3 of comparison) It consists of Cu-0.15Sn, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0039] (Example 4 of comparison) It consists of Cu-13Zn, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0040] (Example 5 of comparison) It consists of Cu-4.0Zn-0.3Sn, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0041] (Example 6 of comparison) It consists of Cu-0.6Ag, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0042] (Example 7 of comparison) It consists of Cu-0.15Ag, and except using the core wire whose outer diameter is 7.1mm, like an example 1, Zn concentration of a Cu-Zn alloy-plate layer is 35wt(s)% and 40wt%, respectively, and two kinds of electrode-for-electric-spark-machining lines whose thickness is 31 micrometers are produced.
[0043] (Conventional example 1) It consists of a Cu-35Zn alloy simple substance, and the electrode-for-electric-spark-machining line whose outer diameter is 0.25mm is produced.
[0044] (Conventional example 2) It consists of a Cu-40Zn alloy simple substance, and the electrode-for-electric-spark-machining line whose outer diameter is 0.25mm is produced.
[0045] In addition, all the units of the chemical composition in examples 1 and 2, the examples 1-7 of comparison, and the conventional examples 1 and 2 are wt%.
[0046] The item of the core wire in examples 1 and 2, the examples 1-7 of comparison, and the conventional examples 1 and 2 is shown in Table 1.
[0047]
[Table 1]

		芯線の特性				電極線の放電加工速度	
		組成 (wt%)	高温強度 (MPa)	導電率 (%IACS)	伸線加工性	α相被覆 (Cu-35Zn)	α+β相被覆 (Cu-40Zn)
実施例	1	Cu-0.16Zr	255	80～90	○	1.16	1.21
	2	Cu-0.19Sn-0.2In	181	76	◎	1.15	1.20
比較例	1	Cu-2.0Sn	196	30～40	△	1.11	1.16
	2	Cu-0.3Sn	176	73	○	1.12	1.17
	3	Cu-0.15Sn	166	83	◎	1.13	1.18
	4	Cu-13Zn	96	25～30	○	1.11	1.16
	5	Cu-4.0Zn-0.3Sn	176	50	○	1.10	1.15
	6	Cu-0.6Ag	245	88	△	1.15	1.20
	7	Cu-0.15Ag	245	94	○	1.15	1.20
従来例	1	Cu-35Zn	——	———	○	1.00	
	2	Cu-40Zn	——	———	△	1.03	

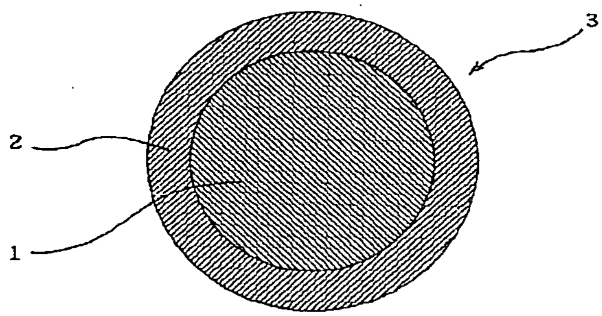
[0048] Next, evaluation of the high temperature strength (MPa) of the core wire in examples 1 and 2, the examples 1-7 of comparison, and the conventional examples 1 and 2, conductivity (%IACS), and wire drawing nature was performed. Similarly the evaluation result is shown in Table 1.
[0049] Here, as a high temperature strength, after carrying out the wire drawing of the core wire with an outer diameter of 7.1mm to phi0.2mm, respectively, tensile strength is measured about what was held for 10 minutes at 300 degrees C supposing the service temperature at the time of an electron discharge method. Moreover, the value of conductivity is also measured about the thing after wire drawing. It evaluates about the generating situation of the open circuit when actually performing wire drawing about wire drawing nature using a dice, and continuing wire drawing on both sides of heat treatment as occasion demands during wire drawing, the grade of the reduction which can be taken by the one pass, a working limit, etc., and wire drawing ease and O express the wire drawing possibility of to wire drawing, and, as for **, the double circle expresses those with difficulty.
[0050] Next, electron discharge method evaluation was performed about two kinds each of electrode-for-electric-spark-machining lines of examples 1 and 2, the examples 1-7 of comparison, and the conventional examples 1 and 2. Similarly the evaluation result is shown in Table 1.
[0051] Electron discharge method evaluation measures the electron discharge method speed when processing a 60mm workpiece (JIS SKD-11) using an electron discharge method testing machine (the Mitsubishi Electric make, FX10). In addition, a working speed is a relative ratio when setting the working speed (a part for 2.184mm/) of the conventional example 1 to 1.00.
[0052] Consequently, it turns out that electron discharge method speed is all increasing the electrode-for-electric-spark-machining line of examples 1 and 2 and the examples 1-7 of comparison as compared with the conventional examples 1 and 2. The factor of this increase is considered to be because for the electrode-for-electric-spark-machining line to have adopted covered type structure. That is, it is meaningful technically to use structure of an electrode-for-electric-spark-machining line as a covered type from an alloy simple substance type, and electron discharge method speed increases by this.
[0053] On the other hand, the result which carried out comprehensive evaluation of the increase grade of electron discharge method speed with the property of a core wire is shown below about each electrode-for-electric-spark-machining line of the examples 1 and 2 from which the quality of the material of a core wire differs, and the examples 1-7 of comparison.
[0054] Both the electrode-for-electric-spark-machining lines of examples 1 and 2 have a high temperature strength and enough conductivity, and are large, and can accept the outstanding effect. [of the increase

grade of electron discharge method speed]
[0055] On the other hand, since the electrode-for-electric-spark-machining line of the example 1 of comparison has difficulty in wire drawing nature, manufacture of an electrode-for-electric-spark-machining line is difficult for it.
[0056] The electrode-for-electric-spark-machining line of the example 2 of comparison does not have enough conductivity, and its increase grade of electron discharge method speed is not enough.
[0057] The electrode-for-electric-spark-machining line of the example 3 of comparison does not have an enough high temperature strength, and its increase grade of electron discharge method speed is not enough.

[0058] The electrode-for-electric-spark-machining line of the example 4 of comparison has a remarkably low high temperature strength, and has a possibility that problems, such as an open circuit, may arise at the time of an electron discharge method.
[0059] The electrode-for-electric-spark-machining line of the example 5 of comparison has low conductivity, and its increase grade of electron discharge method speed is small.
[0060] Since, as for the electrode-for-electric-spark-machining line of the examples 6 and 7 of comparison, Cu alloy of core-wire material contains Ag, generally raw material cost becomes high.
[0061] (Example 3) It consists of Cu-0.16Zr, and it consists of Cu-40Zn, the core wire whose outer diameter is 7.1mm is inserted into the Cu-40Zn alloy pipe whose wall thickness an outer diameter is 10mm and is 1.2mm, and the multiple-unit tube is formed.
[0062] After performing wire drawing to this multiple-unit tube and forming in phi7.9mm, heat treatment of 450 degree-Cx1hr is performed. Next, after performing wire drawing to a phi7.9mm compound line and forming in phi1.2mm, heat treatment beyond 450 degree-Cx1hr is performed.
[0063] Finally, wire drawing is performed to a phi1.2mm compound line to phi0.25mm, according to the grade of heat treatment, the concentration distribution of the range whose Zn concentration of a Cu-Zn alloy-plate layer is 35 - 45wt% is shown, Zn concentration of the surface section (a front face to about 5 micrometers layer) is lower than the interior of the surface section, and the thickness of a Cu-Zn alloy-plate layer produces about 31-micrometer electrode-for-electric-spark-machining line on the whole.
[0064] (Example 4) Except consisting of Cu-0.19Sn-0.2In and using the core wire whose outer diameter is 7.1mm The concentration distribution of the range whose Zn concentration of a Cu-Zn alloy-plate layer is 35 - 45wt% is shown like an example 3. Zn concentration of the surface section (a front face to about 5 micrometers layer) is lower than the interior of the surface section, and the thickness of a Cu-Zn alloy-plate layer produces about 31-micrometer electrode-for-electric-spark-machining line on the whole.
[0065] in the electrode-for-electric-spark-machining line of examples 3 and 4, although a layer with high Zn concentration exists in the interior of an enveloping layer since Zn concentration of the surface section (a front face to about 5 micrometers layer) of a Cu-Zn alloy-plate layer is low with about thirtywt(s)% as shown in drawing 2 , the cold-working nature of an enveloping layer goes up, and wire drawing in ordinary temperature can be performed easily
[0066] In addition, although drawing 2 shows the electrode-for-electric-spark-machining line of an example 4, it cannot be overemphasized by that a result with the same said of the case of the electrode-for-electric-spark-machining line of an example 3 is observed.
[0067]
[Effect of the Invention] In short, according to the electrode-for-electric-spark-machining line of this invention, above by having formed the Cu-Zn alloy-plate layer in the periphery of the core wire which consists of a Cu-0.02 - 0.2Zr alloy or a Cu-0.15-0.25Sn-0.15 - 0.25In alloy With the advantageous structure which a manufacturing cost is cheap, has sufficient conductivity and a sufficient high temperature strength as compared with the case where well-known Cu alloyed wire is conventionally used for a core wire, and can raise the increase grade of electron discharge method speed by that cause And the outstanding effect that an efficient electrode-for-electric-spark-machining line can be obtained is demonstrated.

[Translation done.]

Drawing selection [Representative drawing]



[Translation done.]